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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

FOREST INSECT HAZARD RATINGS FOR THE EAGLE LAKE TRACTS OF THE FRUIT GROWERS SUPPLY COMPANY AND THE RED RIVER LUMBER COMPANY IN T 31 N. RANGES 10 and 11 E, M.D.M. LASSEN COUNTY, CALIFORNIA

by
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Berkeley, California
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During the 1937 field season, the work of the Hazard Inventory Project of the Berkeley Laboratory of the Bureau of Entomology and Plant Quarantine has been concentrated in the east side type stands of the Lassen area. This project was developed as a result of recent research work of this Bureau which has strongly emphasized the point that the highest timber losses in these east side forests have recently appeared in areas which conform to recognizable zones of hazard from bark beetle infestations. It has further been found that the characters which define these areas of relatively high losses are recognizable not only by the intensity of past losses but also by symptoms that are evident in the surviving trees on the stand.

The objective of the survey covered by this report was to obtain basic information on the loss history of the Eagle Lake tract and on the present condition of the three needle pines (ponderosa and Jeffrey pines). The value of that information lies in its use as a measure of the hazard of future insect attack in this area and of the desirability of control, management and utilization practices that will reduce or minimize the threat of insect caused destruction of forest capital.

LAND OWNING AGENCIES INTERESTED.

In parts of the eastern Lassen area the Red River Lumber Company and the Fruit Grower's Supply Company both have valuable interests as land owners and as operators of active logging projects. Both companies have expressed an interest in the interpretation of field data collected on the Hazard Inventory Project and in the course of field action that might be suggested by the data. Inasmuch as the unit area shown in figure 1 is chiefly under the administration of the two companies, the results of the field work in that area have been summarized and interpreted to furnish a typical example of the kind of information it will be possible to supply to organizations interested in forest protection and utilization. The Forest Service as well as other companies utilizing forest resources in east side stands are intensely interested in the manner in which this type of information will apply to other areas in Northern California.

OWNERS ACT TO CURB INFESTATIONS.

Insect caused losses were found to be increasing in this unit in 1931. Subsequent infestations had a telling effect in reducing values, the infestation of 1934 killing a volume estimated to be greater than 800 b.m. per acre. In 1936 the Fruit Grower's Supply Company acted to salvage some of the values by selectively cutting stands on about a

thousand acres of their holdings. They left a fairly heavy reserve in which subsequent losses seem to be relatively light. At the present time the Red River Lumber Company is considering a similar type of treatment. However, at this date, most of the stand values remain unutilized and subject to a relatively high hazard of continued depletion as a result of attacks by forest insects.

BUREAU FIELD CREWS CLASSIFY HAZARD.

Intensive field work in the Lassen area during the 1936 season resulted in the development of a tentative classification of hazard from insect loss based on records of past loss. In that classification five grades of hazard were recognized (1). Of these the third and fourth class

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1. Salman, K. A. and Johnson, P. C. The Forest Insect Hazard Inventory of East Side Forest Areas; Preliminary Report on Methods and Their Application. Sept. 21, 1937.

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limits were found to apply to the unit area shown in figure 1. In the 1936 work, areas were placed in the third class if past losses, for the period of time normally covered by the survey, amounted to from ten to twenty percent of the pine stand. They were placed in the fourth class if the losses ranged from twenty to thirty-five percent of the stand. However, it is not implied that these expressions of class limits now are fixed and certain. Development of the conception of classification of hazard from future insect losses is still in a preliminary stage and changes undoubtedly will be made as the work progresses.

FACTORS CONSIDERED IN CLASSIFICATION.

The 1936 field work showed that a knowledge of the total stand and of the type and amount of loss that has occurred over a relatively long period of time must be measured to supply a basis for rating hazard. The 1937 field work in this area measured the stand and the losses by sample cruises of 186.2 acres. In addition the cruise also secured stand and loss figures for other species of trees represented on the area. Another measure of hazard to the pine stand also was secured. Living three needle pines on the strips were classified on the basis of recently discovered symptoms indicating susceptibility. The susceptibility of the stands was rated according to the proportion of highly susceptible trees in them.

TWO HAZARD RATINGS APPLIED TO AREA.

A reconnaissance of the area indicated that there were two relatively small units in which past losses have been lighter and present stand conditions are better than the average of the area as a whole. The sample strips corroborated this observation by showing that losses and the present susceptibility of stands on about 6,000 acres justified rating them in the third hazard class. Conditions on the remaining 20,000 acres justified considering the stand subject to a hazard of the fourth class. This division of the area is shown by figure 1.

TIMBER RESOURCES OF AREA.

Timber types are as shown in figure 1. Site quality is average to poor, being considered site III or IV in different parts of the area. The stand figures that were calculated from the cruised sample are given in the following table.

TABLE I
STAND COMPOSITION

Tree species	Hazard III			Hazard IV		
	Stand per acre trees	volume	% tot. stand	Stand per acre trees	volume	% tot. stand
Ponderosa pine	13.1	14,448	54.7	9.9	9,777	43.5
Jeffrey pine	0.7	1,475	5.5	3.4	2,977	13.2
White fir	9.2	5,690	21.6	11.7	5,652	25.1
Sugar pine	2.3	2,769	10.5	2.0	1,686	7.5
Incense cedar	2.9	1,904	7.2	3.8	2,350	10.5
Douglas fir	0.1	123	0.5			
Red fir				0.1	45	0.2
Totals	23.3	26,391	100.0	30.9	22,487	100.0

This information enables one to visualize the stand differences on the areas of different hazard as well as to determine the probable volumes, qualities and values that might be taken from the present stand under current utilization practice.

PINE LOSSES HEAVY.

The fact that past losses have been heavy already has been mentioned. The following table summarizes the loss figures secured by the cruise and gives one of the reasons why different hazard ratings have been applied to different parts of the area.

TABLE II
PERCENT OF THREE NEEDLE PINE STAND KILLED DURING THE PAST TEN YEARS

Hazard Class of Area (Fig. 1)	Pine stand per acre trees	volume	Loss per acre trees	volume	Percent killed
III	13.8	15,923	1.7	2,279	12.5
IV	13.3	12,754	3.1	3,707	22.5
Ave. entire area	13.4	14,231	2.4	3,037	17.6

The above figures are the ones that have been utilized in determining the hazard ratings of the stands. The conclusions that can be drawn from them concerning stand differences and hazard ratings are given greater weight by the fact that the susceptibility figures for the same areas lead to the same conclusions.

OTHER TREE SPECIES SUFFER FROM FOREST INSECT ATTACKS.

Losses in three needle pines are not the only ones that have been suffered by the stands on this area. Both white fir and sugar pine have suffered heavy losses as shown in the following table.

TABLE III
INSECT CAUSED LOSSES IN OTHER TREE SPECIES

Tree species	Hazard III			Hazard IV		
	Loss per acre trees	volume	% vol. killed	Loss per acre trees	volume	% vol. killed
White fir	4.1	4,475	44.0	3.7	3,430	37.8
Sugar pine	0.1	333	10.7	0.3	589	25.8
Incense cedar				0.04	31	1.3

It is interesting to note that the losses in sugar pine on the areas of different hazard vary about as do the losses in three needle pines. However, no such difference can be noted in the white fir situation.

HAZARD RATINGS RELATIVE.

The loss figures that have resulted from the sample cruises and which are used in rating the hazard, show a marked difference in the loss history of the areas of different hazard. However, the use of those figures as one of the factors in rating hazard and prognosticating future loss possibilities rests on the assumption that history will repeat itself. That probably will be true in general. However it is unlikely that, if twenty percent of a pine stand has been killed on one area during the past ten years, another twenty percent will be killed in the next ten years on the same area. The chief value of the loss data is in indicating the probable future relative loss conditions on areas of different hazard. Losses are the result of all the interaction of environmental factors that are concerned in forest insect activity. If, in the past those factors have created an environmental pressure that, on two areas has resulted in twice as much loss on one area as on the other, it is logical to conclude that approximately the same relation will continue to exist with little change.

HEALTH OF GREEN STAND IMPORTANT IN RATING HAZARD.

Present stand conditions must play an important part in determining the future hazard from loss. If the susceptibility of todays stand can be measured, it should be possible to secure figures showing how much loss may be expected in the near future. Of course, losses will be affected greatly by future environmental conditions. However, the susceptibility of the present stand should remain as a relative index of infestation possibilities. If past losses are, as they seem to be, of value in determining hazard, the susceptibility of the living trees should supplement those figures and have a similar value.

FLATHEAD BORER INFESTATIONS FOUND IN LIVING TREES.

A close relation appears to exist between flathead borer infestations and possibilities of loss. Flathead borers have been found to be the first in attacking the subcortical region of many of the trees that have succumbed to the attacks of forest insects. In addition many green trees have been found to contain flathead infestations which have not yet become successful. Preliminary results have indicated that such infestations may change the life expectancy of those trees. It is logical to conclude that the part of the stand in which such incipient infestations occur is the susceptible part that will be concerned with future non-accidental infestations. The percent of a stand that is infested and considered to be susceptible should be a measure of the hazard or possibility of future loss.

INFESTED TREES SHOW SYMPTOMS OF ATTACK.

Trees that contain incipient flathead borer infestations show symptoms of the insect activity. Usually the symptoms consist of abnormal foliage conditions. Gradations of intensity and of success of infestations have been found to occur as well as gradations in the development and number of symptoms of attack.

SYMPTOMS USED IN CLASSIFYING SUSCEPTIBILITY.

A preliminary classification of susceptibility has been developed in which the visible symptoms of infestation are used as the bases for the classification. This grading of tree condition has been checked by detailed analyses of felled green trees whose susceptibility was classified before the trees were felled. However, the limits of each susceptibility class and the definite characters used in the diagnosis have not yet been well enough defined to state them in precise terms.

Four classes have been used in separating green trees according to their apparent susceptibility to insect attack. Class I is the least susceptible. The trees placed in this group show no evidence that they contain incipient flathead infestations. Class II contains trees in which the symptoms may be indicated but are not definite or well developed. Trees placed in this group are relatively healthy trees but are not above suspicion. Trees in classes III and IV are those considered to be susceptible and in which symptoms of incipient flathead infestations are distinct. The difference between these two classes is chiefly one of the degree of development of visible evidences of infestation. Trees in class IV are those we expect to constitute a major portion of the loss in the next few years.

We have classified, analyzed and checked carefully the incipient infestations in over a thousand green trees. Many more trees have been classified but not analyzed. In one sample, the classification was found to be eighty-five percent correct. Other samples showed a lower or higher accuracy. It is probable that an accuracy of from seventy to ninety percent can be expected.

SUSCEPTIBILITY OF STAND DETERMINED.

The above classification was applied to the three needle pine stand on the cruise strips with the following results.

TABLE IV

TREES, VOLUMES, AND PERCENT OF THREE NEEDLE PINE STAND IN SUSCEPTIBLE CLASSES

Susceptibility class or classes	Hazard III			Hazard IV		
	trees per ac.	volume per ac.	% pine stand	trees per ac.	volume per ac.	% pine stand
IV	0.2	373	2.3	0.6	918	7.2
III	0.7	1,367	8.6	1.2	1,859	14.6
III plus IV	1.0	1,740	10.9	1.8	2,777	21.8
II	2.9	4,833	30.4	3.4	3,849	30.2
II plus III plus IV	3.9	6,573	41.3	5.2	6,625	51.9

The per tree volume of trees in the susceptible classes is slightly above the average for the stand as a whole. This indicates that the mature and overmature trees predominate in the susceptible classes and that the utilization values of those trees may be greater than the average for the stand. However it has been found in other areas that the cull factor due to rot may be higher than the average. This may offset the benefits derived from positive utilization values.

WHAT DO THESE SUSCEPTIBILITY FIGURES MEAN?

The figures mean that, on the hazard III area, 2.3 percent of the stand exhibits symptoms indicating that the trees are well on their way toward death. On the hazard IV area the percentage is 7.2. The volume in this class we believe will be the volume concerned in most of the losses of the next few years.

On the hazard III area an additional 8.6 percent and on the hazard IV area an additional 14.6 percent of the stand shows definite symptoms of decline. It is to be expected that some of the volume represented by these figures will die in the next few years or that these trees will continue to decline and form the highest susceptibility class when most of the individuals now in the fourth susceptibility class have been killed off. However, it is possible that some of the trees now classified in the third class could, with the inception of more favorable environmental conditions, recover and become less susceptible.

On both areas another thirty percent of the stand is not particularly susceptible nor can it be given a clear record of health. In the future some of these trees undoubtedly will show a continued development of symptoms of susceptibility. Others will recover.

A larger proportion of the green stand has been found to be weakened on those parts of the Eagle Lake Tract that have been given the higher hazard rating than on the areas considered to be subject to less hazard from insect attack. This information supplements that secured by measuring past loss. It leads to the same conclusions that may be drawn from the loss history and furnishes convincing evidence that the hazard ratings have a basis in fact. The loss figures show that marked differences occurred on the areas of different hazard in the past. The susceptibility figures show that similar differences can now be discerned in the living pine stand.

HOW MAY THE HAZARD INVENTORY RESULTS BE USED?

Loss history and present stand susceptibility appear to be good indices of hazard from insect caused loss. By using those indices we have classified areas according to hazard. The hazard rating that is given to a stand can be of considerable value by indicating the desirable management and protection practices that may be applied to an area. The hazard ratings of areas can, in general, outline (1) the order of utilization of parts of large bodies of timber containing areas of different hazard: (2) the degree of management that may be necessary to maintain timber production on those areas: (3) the types of control action that may be effective on areas of different hazard.

ORDER OF UTILIZATION.

Present utilization practice is based on a heavy volume cut and a relatively long cutting cycle. Under those conditions, coverage of large areas is slow. In most areas of relatively high hazard, the destruction of valuable overmature volume now available for utilization will be great before much of the area can be logged. However, if present cutting cycles and logging practices have to be continued, the loss and susceptibility data can be used intelligently in selecting the areas of greater hazard to be cut first.

DEGREE OF MANAGEMENT.

Concerning this point nothing definite is known. However, where insect caused losses are a factor, it is probable that the greater the hazard from loss, the more frequent and intensive the attention that is required to keep the stand in good shape. This is because of the more rapid decline of susceptible trees and the greater tendency for healthy trees to become susceptible.

TYPE OF CONTROL ACTION ADVISABLE.

Under favorable conditions, direct methods of controlling forest insect infestations are effective. This appears to be true in areas of low hazard and in areas of higher hazard during periods when the environmental pressure on the stands has been reduced. However, the greater the hazard the less the possibility of effectiveness of direct methods of forest insect control. This appears to be true because of the rapidity of change in susceptibility of trees in the stand and because continued unfavorable environmental levels provide a plentiful supply of very susceptible host material. These conditions emphasize the temporary

effects of the direct forest insect control methods and make advisable continued maintenance control with its attendant increase in protection costs.

Indirect methods of control appear to be the best ones for use in areas of high hazard. These methods essentially attempt to maintain the stand in the healthiest condition possible. Tests of these methods are now under way. However, until results of those tests are available we must rely on general observations and experience to judge the probable effect of indirect methods. If loss records and the evidence presented by Dunning and Keen in their tree classifications are any criterion, the types of trees now being considered susceptible will be the types of trees that will be concerned in future losses.

There are several possible degrees of application of indirect control measures. Specifically, on the area shown in figure 1 the removal of 373 b.m. per acre on the hazard III area should reduce the insect caused loss for the next few years. On the hazard IV area it would be necessary to remove selected susceptible trees in the amount of 918 b.m. per acre in order to produce a similar effect. A more permanent effect should be secured by removing the volumes listed in table IV in susceptibility classes III and IV. These volumes include the trees we know are weakened. A still more prolonged effect of the work should be secured by removing the volumes listed in susceptibility class II as well. In any event application of indirect methods should contemplate a periodic removal of unhealthy trees on a relatively short cutting cycle. The chief objection that might be raised against such a program would be the light volume cut. No objection could be raised against the product quality as only green trees would be taken and no bluestain degrade should result from the incipient infestations in the weakened trees.

WHAT LIMITATIONS EXIST?

The physical conditions that might limit the use of indirect control measures in the unit shown in figure 1 or in the entire eastern Lassen area, are not of sufficient importance to be serious bars to the application of those measures. However, economic limitations are important. In fact, effective application of these measures may be difficult unless drastic changes are made in existing equipment and methods of logging, transportation and manufacture.

If indirect control methods are to be successful, it will be necessary to meet the problems concerned with the cost of building and maintaining an adequate system of utilization roads. It will be necessary to fit existing railroad facilities into a plan for light cutting over a large area and to develop mobile logging units. The real job, in applying indirect control on a commercial basis, will be to spread the operation over large areas that logically will contribute logs to existing mills, harvest individual trees that otherwise would die and rot, and do this with costs sufficiently low to leave a margin of profit.

THE BROAD VIEWPOINT.

The Eagle Lake Tract is but a small part of the eastern Lassen area. The eastern Lassen area is but a small part of the east side subregion. The entomological and utilization problems in the small area, though much less difficult to solve, are similar to those of the larger areas. Existing utilization programs involve a heavy cut and a slow area coverage. However, these programs do not consider the entomological factors and fail to meet the problems created by hazard and loss. It is because of this that we have proposed to study the hazard over the entire east side subregion. On the basis of such knowledge as we have accumulated up to this time in the eastern Lassen area practical corrective or control measures may be developed as a result of that work.

Tentative proposals of measures to reduce hazard and loss include the following. (1) Operate first in areas of high hazard. (2) Secure a rapid coverage with corrective treatments on as large an area as possible. (3) Keep the stands healthy by periodic cutting of susceptible stand elements. (4) Do the above with light selection cuttings that have as their primary consideration the removal of susceptible trees before they die and have a chance to contribute to loss and hazard.

The extent to which private and public administrators can go in applying these measures depends to a great extent on financial considerations. However, the extreme of hazard reduction need not be the immediate goal. Operations that compromise the hazard reduction element of the work to meet the resources available to the operator should be of some benefit. At least the hazard reduction programs should be considered from all angles before they are rejected in favor of others yielding greater immediate but possibly smaller ultimate returns.

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HAZARD RATINGS

EAGLE LAKE TRACT

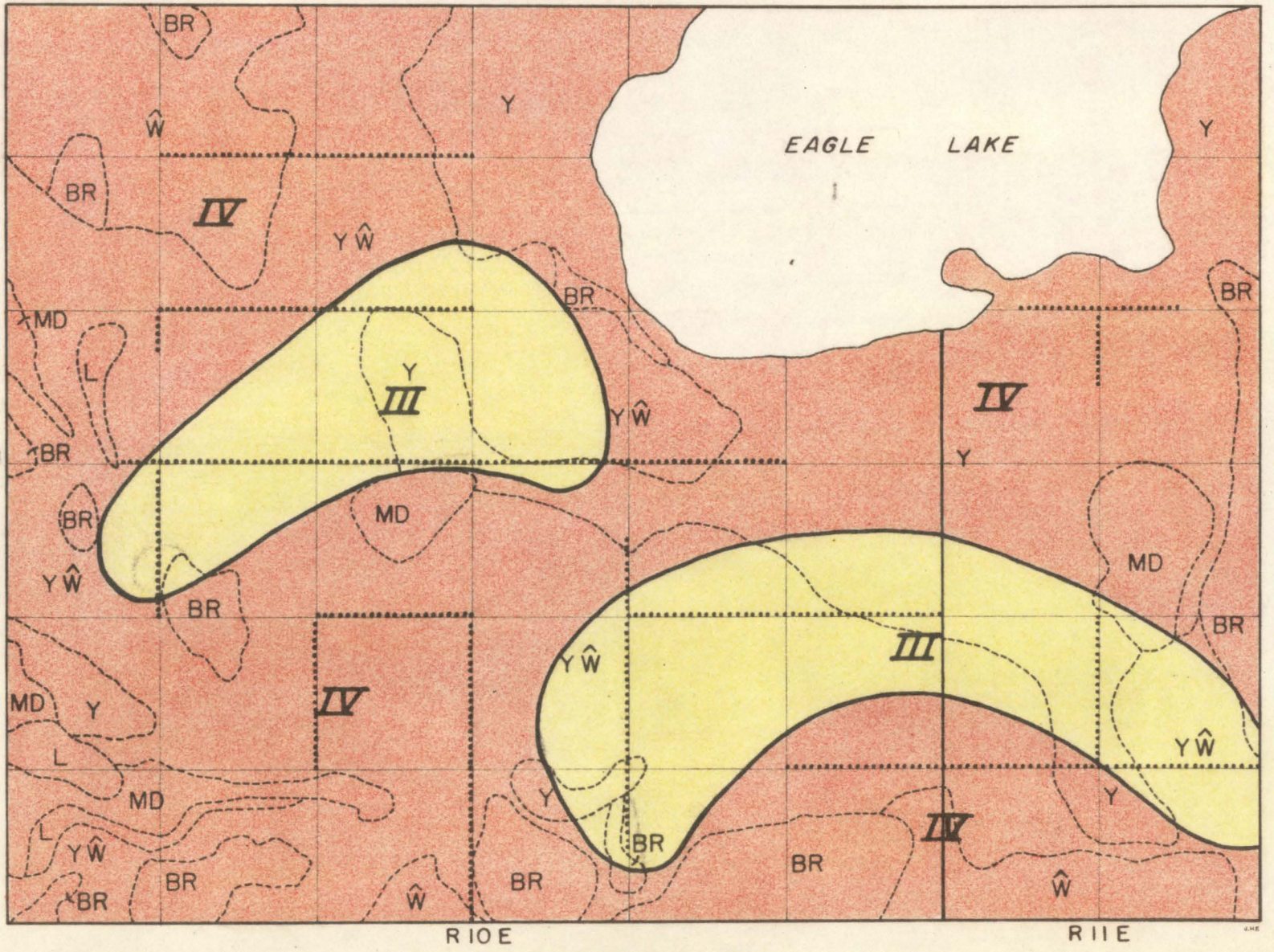

FIG. 1